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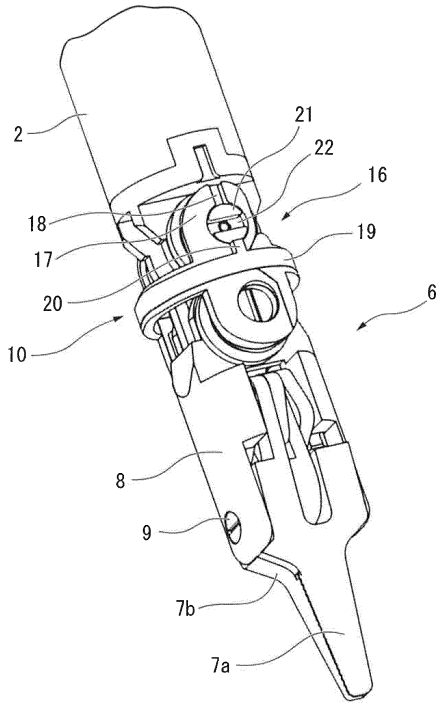
(54) SURGICAL IMPLEMENT AND MEDICAL TREATMENT MANIPULATOR

(57) This surgical instrument (1) is a surgical instrument (1) that performs treatment on treatment target sites and is provided with: a long tubular member (2) with a moderately long shaft; a treatment unit (6) connected to the long member (2); and a connector (10) that detachably connects the long member (2) to the treatment unit (6). The connector (10) comprises a first rotation shaft (13) that is fixed to the long member (2) and can be connected to the treatment unit (6), and a locking unit (16) that locks the first rotation shaft (13) and the treatment unit (6).

FIG. 2



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Description

Technical Field

[0001] The present invention relates to a surgical instrument and a medical treatment manipulator.

[0002] Priority is claimed on US Provisional Patent Application No. 61/515203 filed August 4, 2011, the content of which is incorporated herein by reference.

Background Art

[0003] A conventionally known medical treatment manipulator is a master-slave type medical treatment manipulator including a master manipulator operated by an operator and a slave manipulator that operates on the basis of signals sent from the master manipulator. A surgical instrument has a treatment part for treating a treatment target portion by remote-control operation, and is attached to the medical treatment manipulator.

[0004] For example, Patent Document 1 discloses a medical treatment manipulator that enables a plurality of treatment parts appropriate for treatment to be switchingly attached to the arm of one slave manipulator.

Prior Art Documents

Patent documents

[0005] Patent Document 1
Japanese Unexamined Patent Application, First Publication No. 2001-277157

Summary of the Invention

Problems to be Solved by the Invention.

[0006] Generally, to prevent infection, a medical treatment manipulator is washed and disinfected each time surgery is performed. For example, in the case of the medical treatment manipulator described in Patent Document 1, the treatment part can be made detachable from the slave manipulator, and maintenance such as washing and disinfection is therefore easy. However, since a great many components are required to realize a configuration that enables the treatment part to be made detachable, the treatment part of the medical treatment manipulator described in Patent Document 1 has a complex structure, and cannot be said to be easier to wash.

[0007] It is an object of the present invention to realize an attachable treatment part with a simple structure and to provide a surgical instrument and a medical treatment manipulator that are easy to wash.

Means for Solving the Problem

[0008] According to a first aspect of the present invention, a surgical instrument for performing treatment to a treatment target portion includes: a cylindrical elongated member with a long axis, a treatment part connected to the elongated member, and a connection part that detachably connects the elongated member to the treatment part. The connection part includes a first turning axis part provided to the elongated member, a second turning axis part provided to the treatment part, a first rolling guide part that is provided to the elongated member and includes a circular-are-shaped part coaxial with the first turning axis part, a second rolling guide part that is provided to the treatment part and includes a rolling guide part having a circular-are-shaped part coaxial with the second turning axis part, the rolling guide part rollingly contacting the first rolling guide part, and an engaging part that brings the treatment part and the elongated member into an engaging state. The connection part is detachable between the first turning axis part and the second turning axis part.

[0009] The engaging part may include a main unit that is connected to the first turning axis part and is capable of engaging with the second turning axis part, a ring-shaped member that is provided separately from the main unit, and binds the main unit together with the second turning axis part, and a locking member that switches between a bound state and a released state, wherein in the bound state, the ring-shaped member is arranged in a position where it binds the main unit and the second turning axis part, and in the released state, the ring-shaped member is arranged in a position deviated from the position where it binds the main unit and the second turning axis part.

[0010] The main unit may include a groove that engages with the ring-shaped member and defines its movement direction. The locking member may include one part of the groove and is capable of moving relative to the main unit. When the groove provided in the ring-shaped member and the groove provided in the main unit are in a communicating state, the locking member is capable of switching between the bound state and the released state. When the groove provided in the locking member and the groove provided in the main unit are in a non-communicating state, the treatment part may be held in the bound state with respect to the elongated member.

[0011] The surgical instrument of the above aspect may further include: a treatment tool piece provided on the treatment part and is capable of operating, a joint for operating treatment tool piece that connects the elongated member to the treatment tool piece, and a moving member that is connected to the joint for operating treatment tool piece in order to operate the treatment tool piece. The joint for operating treatment tool piece may include a first operation turning member that is connected to the moving member and turns around a predetermined center of turning, a second operation turning member that is connected to the first operation turning member such that it turns in the opposite direction relative to the first operation turning member coaxial with the second turning axis part or around a center of turning that is near-

er to the turning axis part than the second turning axis part, and a link that converts the rotational force of the second operation turning member to an operation of the treatment tool piece. The joint for operating treatment tool piece is detachable between the first operation turning member and the second operation turning member by being detachable from the connection part.

[0012] The surgical instrument may include a pair of the treatment tool pieces, the operation of the treatment tool pieces being an operation of opening and closing them.

[0013] According to another aspect of the present invention, a medical treatment manipulator includes: the surgical instrument described above, a slave manipulator including at least one joint, the surgical instrument being attached to the slave manipulator, and a master manipulator that sends operating commands for driving the joint of the slave manipulator.

Effects of the Invention

[0014] According to the present invention, the surgical instrument and the medical treatment manipulator are provided with a conventional configuration and configured with an attachable treatment part.

Brief Description of the drawings

[0015]

FIG. 1 is an overall view of a medical treatment manipulator including a surgical instrument according to one embodiment of the present invention.
FIG. 2 is a perspective view of the configuration of one part of the surgical instrument.
FIG. 3 is an explanatory view of the configuration of one part of the surgical instrument.
FIG. 4 is an explanatory view of the configuration of one part of the surgical instrument.
FIG. 5 is an explanatory view of the configuration of one part of the surgical instrument.
FIG. 6 is an exploded perspective view of the configuration of a treatment part of the surgical instrument.
FIG. 7 is an explanatory view of a bend operation of a treatment part of the surgical instrument.
FIG. 8 is an explanatory view of a bend operation of a treatment part of the surgical instrument.
FIG. 9 is an explanatory view of a bend operation of a treatment part of the surgical instrument.
FIG 10 is an explanatory perspective view of an operation of attaching and detaching a treatment part provided to the surgical instrument.
FIG. 11 is an explanatory perspective view of an operation of attaching and detaching a treatment part provided to the surgical instrument.
FIG. 12 is an explanatory perspective view of an operation of attaching and detaching a treatment part provided to the surgical instrument.
FIG. 13 is an explanatory perspective view of an operation of attaching and detaching a treatment part provided to the surgical instrument.
FIG. 14 is an explanatory perspective view of an operation of attaching and detaching a treatment part provided to the surgical instrument.
FIG. 15 is a perspective view of the configuration of another modified example of the embodiment.
FIG. 16 is an explanatory perspective view of an effect of the modified example.
FIG. 17 is a perspective view of the configuration of a modified example of the embodiment.
FIG 18 is a cross-sectional view of the configuration of the modified example.

Embodiments of the Invention

[0016] A surgical instrument 1 and a medical treatment manipulator 100 according to one embodiment of the present invention will be explained. FIG. 1 is an overall view of a medical treatment manipulator including a surgical instrument of the embodiment. FIG. 2 is a perspective view of the configuration of one part of the surgical instrument. FIGS. 3 to 5 are explanatory views of the configuration of one part of the surgical instrument. FIG. 6 is an exploded perspective view of the configuration of a treatment part on the surgical instrument. FIGS. 7 to 9 are explanatory views of a bend operation of a treatment part on the surgical instrument. FIGS. 3 to 5 and FIGS. 7 to 9 are explanatory schematic views of the configuration of the embodiment, and in some cases do not accurately depict the shapes of the members.

[0017] The surgical instrument 1 is attached to the medical treatment manipulator 100 as one part thereof.

[0018] Firstly, the configuration of the medical treatment manipulator 100 of the embodiment will be explained. As shown in FIG. 1, the medical treatment manipulator 100 includes a master manipulator 101, a control device 110, and a slave manipulator 120.

[0019] The master manipulator 101 functions as a master for transmitting the movements of the operations performed by the surgeon to the slave manipulator 120, and includes a master display unit 102 such as a liquid crystal display device, and an operation unit 103 which the surgeon grasps and operates. Operations performed to the operation unit 103 of the master manipulator 101 are input to the control device 110.

[0020] The control device 110 includes a master-side control device 111 that receives the input from the master manipulator 101, and a slave-side control device 112 that outputs a drive signal to the slave manipulator 120.

[0021] Based on the input from the master manipulator 101, the master-side control device 111 generates an operating command for operating the slave manipulator 120, and outputs it to the slave-side control device 112.

[0022] Based on the operating command from the master-side control device 111, the slave-side control

device 112 generates a drive signal for driving the slave manipulator 120, and outputs it to the slave manipulator 120.

[0023] The slave manipulator 120 includes a slave arm 121 that operates in compliance with the drive signal from the slave-side control device 112. The surgical instrument 1 of this embodiment is attached to this slave arm 121. In addition to the surgical instrument 1 of this embodiment, a treatment instrument for performing surgery, an endoscope, and such like, can be attached to the slave manipulator 120.

[0024] Subsequently, the configuration of the surgical instrument 1 will be explained.

[0025] The surgical instrument 1 is a medical instrument for performing treatment to a treatment target portion. As shown in FIGS. 1 and 2, the surgical instrument 1 includes an elongated member 2, a treatment part 6, a connection part 10, and a drive control unit 45.

[0026] In the explanation hereinafter, the side of the surgical instrument 1 including the treatment part 6 will be referred to as the distal side, and the side of the surgical instrument 1 including the drive control unit 45 will be referred to as the proximal side.

[0027] The elongated member 2 is a cylindrical member with a long axis. The elongated member 2 may be flexible or rigid depending on the configuration of the slave arm 121 that it is attached to. In the embodiment, the elongated member 2 is rigid.

[0028] As shown in FIGS. 3 and 7, a connecting rod 3 (moving member) for moving the treatment part 6 is disposed inside the elongated member 2. The connecting rod 3 includes a rod for bending 4, one end of which is connected to a double joint for bending 11 described below and another end of which is connected to the drive control unit 45, and a rod for opening-closing 5, one end of which is connected to a joint for opening-closing 27 described below and another end of which is connected to the drive control unit 45.

[0029] The treatment part 6 is provided for treating the treatment target portion. In the present embodiment, as shown in FIGS. 2 and 6, the treatment part 6 is a forceps including a pair of forceps pieces 7a and 7b capable of opening and closing, and a cover 8 that holds the forceps pieces 7a and 7b. The pair of forceps pieces 7a and 7b are connected to each other by a shaft-shaped member 9 that forms their turning axis.

[0030] The connection part 10 connects the elongated member 2 and the treatment part 6. The connection part 10 includes a double joint for bending 11 for bending the treatment part 6 with respect to the elongated member 2, and a joint for opening-closing 27 for opening and closing the forceps pieces 7a and 7b.

[0031] The double joint for bending 11 includes a first fitting-cogs part 12 (first rolling guide part) fixed to the distal end of the elongated member 2, a first turning axis part 13 connected to the distal end of the elongated member 2, a second turning axis part 14 that extends parallel with the first turning axis part 13 and is connected to the treatment part 6, a second fitting-cogs part 15 (rolling guide part; second rolling guide part) fixed to the treatment part 6, and an engaging part 16 that switches the connecting state of the treatment part 6 and the elongated member 2.

[0032] The first fitting-cogs part 12 has gear-like dent provided in a circle around the center of turning of the first turning axis part 13. The second fitting-cogs part 15 has gear-like dent provided in a circle around the center of turning of the second turning axis part 14, and interlocks with the first fitting-cogs part 12. The cogs of the first fitting-cogs part 12 and the second fitting-cogs part 15 are provided in circles of equal radii, so that their relationship is set at a ratio of 1:1.

[0033] The second fitting-cogs part 15 can rotate while moving along the circumference of the first fitting-cogs part 12. Incidentally, plate-like members that move relatively with contact between their outer peripheral parts due to friction may be provided instead of the first fitting-cogs part 12 and the second fitting-cogs part 15.

[0034] While in the present embodiment, the configuration is one where the first fitting-cogs part 12 and the second fitting-cogs part 15 are brought into frictional contact through the interlocking of cogs, the configuration is not limited to the configuration that is configured through the interlocking of cogs. For example, instead of frictional contact through interlocking of cogs, the configuration can be a mechanism that enables two rotating bodies to rotate and roll smoothly, such as one where two rubber rollers with no interlocking cogs (and large friction) are brought into frictional contact.

[0035] The first turning axis part 13 and the second turning axis part 14 are parallel with each other and have centers of turning that extend orthogonal to the extension line of the long axis of the elongated member 2.

[0036] As shown in FIG 2, the engaging part 16 includes a main unit 17, a ring-shaped member 19, and a locking member 21.

[0037] The main unit 17 maintains a constant distance between the first fitting-cogs part 12 and the second fitting-cogs part 15. The rod for bending 4 of the connecting rod 3 is connected to the main unit 17. When the rod for bending 4 is advanced and retracted in the long-axis direction of the elongated member 2, the main unit 17 turns around the first turning axis part 13. As a result, the second turning axis part 14 swings around the first turning axis part 13.

[0038] The main unit 17 is connected to the first turning axis part 13 such that it can turn relative thereto and cannot be disconnected.

[0039] Moreover, the main unit 17 can engage with the second turning axis part 14 such that the treatment part 6 reaches a predetermined attachment direction with respect to the main unit 17, and can be attached and detached to/from the second turning axis part 14.

[0040] The main unit 17 is provided with a guide 18 for limiting the movement direction of the ring-shaped member 19. In the present embodiment, the guide 18 has a

groove formed in the outer surface of the main unit 17 and extending in one direction. A protrusion 20 is formed on the ring-shaped member 19 and fits into the groove that forms the guide 18. The ring-shaped member 19 thus moves along the groove.

[0041] The ring-shaped member 19 is provided separately from the main unit 17, and binds it and the second turning axis part 14. That is, one part of the main unit 17 and one part of the second turning axis part 14 are both inserted into the ring-shaped member 19. The ring-shaped member 19 binds the main unit 17 and the second turning axis part 14 together. The protrusion 20 is provided on the ring-shaped member 19, and fits into the groove (guide 18) formed in the main unit 17.

[0042] When the ring-shaped member 19 is arranged in a position where it binds the main unit 17 and the second turning axis part 14, the treatment part 6 is in a state of being connected to the elongated member 2 (hereinafter 'bound state'). When the ring-shaped member 19 is arranged in a position deviated from the position where it binds the main unit 17 and the second turning axis part 14, the treatment part 6 is in a state where it can be detached from the elongated member 2 (hereinafter 'released state').

[0043] The locking member 21 is provided for switching between the bound state and the released state. The locking member 21 includes a groove 22 that can communicate with the groove (guide 18) formed in the main unit 17. As one part of the guide 18 formed in the main unit 17, the groove 22 formed in the locking member 21 has the function of restricting the movement direction of the ring-shaped member 19.

[0044] The locking member 21 can turn around the center of turning of the first turning axis part 13. When a rotational force around the center of turning of the first turning axis part equal to or greater than a predetermined level has acted as an external force against the locking member 21, the locking member 21 can turn around the center of turning of the first turning axis part 13 relative to the main unit 17. That is, by rotating the locking member 21, an operator can rotate the locking member 21 relative to the main unit 17, and switch the communicating state between the groove 22 formed in the locking member 21 and the guide 18 formed in the main unit 17. In a state where the abovementioned external force for rotating the locking member 21 is not being applied, the locking member 21 integrally operates with the main unit 17.

[0045] When the groove 22 formed in the locking member 21 and the guide 18 formed in the main unit 17 are in the communicating state, the ring-shaped member 19 can move freely along the groove 22 formed in the locking member 21 and the guide 18 formed in the main unit 17. When the groove 22 formed in the locking member 21 and the guide 18 formed in the main unit 17 are in a non-communicating state, the ring-shaped member 19 cannot enter the groove 22 formed in the locking member 21. Therefore, when the groove 22 formed in the locking member 21 and the guide 18 formed in the main unit 17 are in the non-communicating state in the bound state mentioned above, the treatment part 6 is held in the bound state with respect to the elongated member 2.

[0046] As shown in FIGS. 6 to 9, the joint for opening-closing 27 includes a first gear for opening-closing 23 that is connected to the rod for opening-closing 5 and turns coaxially with the first turning axis part 13, a second gear for opening-closing 24 that interlocks with the first gear for opening-closing 23 and turns coaxially with the second turning axis part 14, a rack 25 connected to the second gear for opening-closing 24, a link element 26a that connects the rack 25 to the forceps piece 7a, and a link element 26b that connects the rack 25 to the forceps piece 7b.

[0047] While in the present embodiment, the first gear for opening-closing 23 and the second gear for opening-closing 24 are brought into frictional contact through the interlocking of cogs, the configuration need not be limited to the configuration that is configured through the interlocking of cogs. For example, instead of frictional contact through interlocking of cogs, the configuration may be a mechanism that enables two rotating bodies to rotate and roll smoothly, such as one where two rubber rollers with no interlocking cogs (and large friction) are brought into frictional contact.

[0048] The link elements 26a and 26b shown in FIG. 6 transmit a pulling force, which comes from the rod for opening-closing 5 via first gear for opening-closing 23 and the second gear for opening-closing 24 shown in FIG. 7, through the rack 25. The link elements 26a and 26b convert the advancing-retracting operation of the rack 25 to an opening-closing operation of the forceps pieces 7a and 7b.

[0049] In the present embodiment, the link element 25 of the joint for opening-closing 27 configures a toggle mechanism, with the grasping force of the forceps pieces 7a and 7b increasing exponentially as the forceps pieces 7a and 7b move in the closing direction.

[0050] The drive control unit 45 shown in FIG. 1 includes an actuator 46 that advances and retracts the connecting rod 3 (rod for bending 4 and rod for opening-closing 5) in the longitudinal-axis direction of the elongated member 2, and a detection unit 47 that detects the amount of movement of the actuator 46. The drive control unit 45 operates in compliance with a drive signal output from the slave-side control device 112. The detection unit 47 detects the amount of movement of the actuator 46 and outputs to the slave-side control device 112. Thus the movement of the actuator 46 of the drive control unit 45 is feedback-controlled.

[0051] Subsequently, the effects of the surgical instrument 1 and the medical treatment manipulator 100 of the present embodiment will be explained, focusing on the operating principles and effects of the surgical instrument 1.

[0052] The surgical instrument 1 is used in the state where the treatment part 6 and the elongated member 2 are connected at the double joint for bending 11 and the

joint for opening-closing 27. It is also possible to detach the treatment part 6 from the elongated member 2, and to attach another treatment part 6 to the elongated member 2. For example, treatment can be performed by switching among different types of treatment parts 6, and the treatment part 6 that has suffered an operational malfunction or the like can be replaced with a new treatment part 6 so that treatment can be continued.

[0053] The effects when using the surgical instrument 1 will be explained.

[0054] The double joint for bending 11 can be operated by using the actuator 46 to advance and retract the rod for bending 4. The joint for opening-closing 27 can be operated independently from the double joint for bending 11 by using the actuator 46 to advance and retract the rod for opening-closing 5.

[0055] The effects of the double joint for bending 11 will be explained.

[0056] If the rod for bending 4 is advanced and retracted without advancing and retracting the rod for opening-closing 5, as shown in FIGS. 3 to 5, the second turning axis part 14 turns around the first turning axis part 13. At this time, since the second fitting-cogs part 15 is interlocked with the first fitting-cogs part 12 provided on the double joint for bending 11, the second fitting-cogs part 15 turns around the second turning axis part 14. As the second turning axis part 14 swings around the first turning axis part 13 while the second fitting-cogs part 15 turns around the second turning axis part 14, the direction of the pair of forceps pieces 7a and 7b on the treatment part 6 changes. The pair of forceps pieces 7a and 7b do not open or close at this time.

[0057] In this case, at the double joint for bending 11, the main unit 17 is moved at an angle corresponding to the ratio between the radius of the first fitting-cogs part 12 and the radius of the second fitting-cogs part 15.

[0058] For example, when r1 is the radius of the first fitting-cogs part 12, r2 is the radius of the second fitting-cogs part 15, θ is the rotation angle of the main unit 17, and φ is the rotation angle of the treatment part 6, then

$$r2(\varphi - \theta) = r1\theta \qquad (1)$$

$$\varphi = \{(r1+r2)/\, r2\}\theta \qquad (2)$$

[0059] For example, when the ratio between radius r1 of the first fitting-cogs part 12 and the radius r2 of the second fitting-cogs part 15 is 1:1 (r1 = r2) as it is in the present embodiment, this gives:

$$\varphi = 2\theta.$$

[0060] Therefore, when the main unit 17 is moved 45-degrees around the first turning axis part 13, the second fitting-cogs part 15 provided on the treatment part 6 side tilts 90-degrees with regard to the first fitting-cogs part 12. That is, an acceleration mechanism, which makes it possible to reduce the amount of angular movement of the main unit 17 with respect to the amount of angular movement of the treatment part 6, is achieved.

[0061] Subsequently, the effects when the treatment part 6 is made detachable from the elongated member 2 will be explained.

[0062] FIGS. 10 to 14 are explanatory perspective views of operation of attaching and detaching the treatment part 6.

[0063] When it becomes necessary to detach the treatment part 6 from the elongated member 2, the locking member 21 is rotated relative to the main unit 17, whereby the groove 22 formed in the locking member 21 and the guide 18 formed in the main unit 17 are changed from the non-communicating state (see FIG. 10) to the communicating state (see FIG. 11). For example, the change can be made easily by inserting a flat-blade screwdriver into the groove 22 formed in the locking member 21 and rotating the locking member 21.

[0064] When the groove 22 formed in the locking member 21 and the guide 18 formed in the main unit 17 are in the communicating state, the ring-shaped member 19 can move along the groove 22 in the locking member 21 from the second turning axis part 14 side to the first turning axis part 13 side. As shown in FIG. 12, when the operator moves the ring-shaped member 19 to the first turning axis part 13, the second turning axis part 14 and the main unit 17 are unbound, and, as shown in FIGS. 13 and 14, the second turning axis part 14 and the treatment part 6 connected to the second turning axis part 14 are detached from the main unit 17.

[0065] In the present embodiment, whatever the bend state of the double joint for bending 11, and whatever the open-close state of the joint for opening-closing 27, the treatment part 6 can be detached from the elongated member 2.

[0066] Another treatment part 6 can then be attached, or the detached treatment part 6 can be cleaned before being re-attached.

[0067] When attaching the treatment part 6 to the elongated member 2, the treatment part 6 is positioned such that the first fitting-cogs part 12 interlocks with the second fitting-cogs part 15 and the first gear for opening-closing 23 interlocks with the second gear for opening-closing 24, the second turning axis part 14 is made to engage with the main unit 17, and the ring-shaped member 19 is used to bind the second turning axis part 14 and the main unit 17 together. Thereafter, the locking member 21 is rotated with respect to the main unit 17 so that the groove 22 formed in the locking member 21 and the guide 18 formed in the main unit 17 are in the non-communicating state.

[0068] It thus becomes possible to use the treatment

part 6 attached to the elongated member 2.

[0069] In contrast, according to the surgical instrument 1 and the medical treatment manipulator 100 of the present embodiment, since the main unit 17 and the second turning axis part 14 are bound by the ring-shaped member 19, the treatment part 6 can be made detachable from the elongated member 2 with a simple configuration.

[0070] Also, according to the surgical instrument 1 and the medical treatment manipulator 100 of the present embodiment, the increase in the number of components for attaching and detaching the treatment part 6 is less than that of the prior art described in Patent Document 1.

[0071] Since the treatment part 6 is made detachable from the elongated member 2 by attaching and detaching the first turning axis part 13 to and from the second turning axis part 14, the components of the joint section for changing the direction of the treatment part 6 with respect to the elongated member 2 can be used for making the treatment part 6 detachable. Therefore, in the surgical instrument 1 and the medical treatment manipulator 100 of the present embodiment, the number of components is not considerably greater than a configuration where the treatment part 6 is not detachable.

(Modified example 1)

[0072] Subsequently, a modified example of the present embodiment will be explained. FIG. 15 is a perspective view of the configuration of the modified example. FIG. 16 is an explanatory perspective view of the effects of the modified example.

[0073] As shown in FIG. 15, in the present modified example, instead of the configuration where the main unit 17 and the second turning axis part 14 can be attached and detached, the main unit 17 can be divided into distal members 17A and proximal members 17B.

[0074] As shown in FIGS. 15 and 16, claw parts 48 for engaging with the proximal members 17B are formed on the distal members 17A. Recessed parts 49 for fitting the claw parts 48 of the distal members 17A therein are formed in the proximal members 17B. The claw parts 48 and the recessed parts 49 configure an engaging part 16 that brings the first turning axis part 13 and the treatment part 6 into an engaged state, in the same manner as the engaging part 16 described in the embodiment above.

[0075] When the claw parts 48 of the distal members 17A are pressed into the recessed parts 49 of the proximal members 17B, the proximal members 17B and the distal members 17A elastically deform slightly, and the claw parts 48 enter the recessed parts 49. The treatment part 6 is thus engaged with the elongated member 2.

[0076] The configuration achieves effects similar to those of the embodiment described above.

[0077] In addition, the present modified example has fewer components than the embodiment described above.

[0078] While in the embodiments including the modified example described above, the example of an operation of a treatment tool piece is one of opening and closing a pair of treatment tool pieces, namely the forceps pieces 7a and 7b, the configuration is not limited to the example. For example, the operation may be one which is bending (turning) a single treatment tool piece. The treatment tool piece can be a medical instrument other than forceps pieces.

(Modified example 2)

[0079] Subsequently, another modified example of the embodiment will be explained. FIG. 17 is a perspective view of the configuration of the present modified example. FIG. 18 is an explanatory cross-sectional view of the configuration of the present modified example.

[0080] As shown in FIGS. 17 and 18, instead of the treatment part 6 having the forceps pieces 7a and 7b, the present modified example includes a treatment part 6 having an electric scalpel electrode 50.

[0081] The elongated member 2 includes a lead wire 51 that is electrically connected to the electric scalpel electrode 50. The lead wire 51 and the electrode 50 are detachably connected via a plug 52. The treatment part 6 of the modified example need not be connected to the joint for opening-closing 27, and need not include the joint for opening-closing 27. Also, in the present modified example, the joint for opening-closing 27 and the rod for opening-closing 5 need not be provided.

[0082] This type of configuration achieves effects similar to those of the embodiment described above.

[0083] While an embodiment of the invention has been described in detail with reference to the drawings, the specific configuration is not limited to this embodiment.

[0084] For example, it is acceptable to use a treatment part that bends at the first turning axis part and does not include the second turning axis part described above.

[0085] Various other additions, omissions, substitutions, and other changes can be made to the configuration without deviating from the main points of the invention.

Industrial Applicablity

[0086] The present invention is provided to be capable of being used as a surgical instrument and a medical treatment manipulator. However, the present invention is not limited to be used only in medical fields.

Reference Signs List

[0087]

1	surgical instrument
2	elongated member
3	connecting rod
4	rod for bending
5	rod for opening-closing
6	treatment part

7a, 7b	forceps pieces
8	cover
9	shaft-shaped member
10	connection part
11	double joint for bending
12	first fitting-cogs part (first rolling guide part)
13	first turning axis part
14	second turning axis part
15	second fitting-cogs part (rolling guide part; second rolling guide part)
16	engaging part
17	main unit
17A	distal members
17B	proximal members
18	guide
19	ring-shaped member
20	protrusion
21	locking member
22	groove
23	first gear for opening-closing (first rolling guide part)
24	second gear for opening-closing (rolling guide part; second rolling guide part)
25	rack
26a, 126b	ink elements
27	joint for opening-closing
45	drive control unit
46	actuator
47	detection unit
48	claw parts
49	recessed parts
50	electric scalpel electrode
51	lead wire
52	plug
100	medical treatment manipulator
101	master manipulator
102	master display unit
103	operation unit
110	control device
111	master-side control device
112	slave-side control device
120	slave manipulator
121	slave arm

Claims

1. A surgical instrument for performing treatment to a treatment target portion, the surgical instrument comprising:

a cylindrical elongated member having a long axis;
a treatment part connected to the elongated member; and
a connection part that detachably connects the elongated member to the treatment part, wherein
the connection part comprises:

a first turning axis part provided to the elongated member;
a second turning axis part provided to the treatment part;
a first rolling guide part that is provided to the elongated member and includes a circular-arc-shaped part coaxial with the first turning axis part;
a second rolling guide part that is provided to the treatment part and includes a rolling guide part having a circular-arc-shaped part coaxial with the second turning axis part, the rolling guide part rollingly contacting the first rolling guide part;
an engaging part that brings the treatment part and the elongated member into an engaging state, and
the connection part is detachable between the first turning axis part and the second turning axis part.

2. The surgical instrument according to claim 1, wherein
the engaging part comprises:

a main unit that is connected to the first turning axis part and is capable of engaging with the second turning axis part;
a ring-shaped member that is provided separately from the main unit, and binds the main unit together with the second turning axis part; and
a locking member that switches between a bound state and a released state, wherein in the bound state, the ring-shaped member is arranged in a position where it binds the main unit and the second turning axis part, and in the released state, the ring-shaped member is arranged in a position deviated from the position where it binds the main unit and the second turning axis part.

3. The surgical instrument according to claim 2, wherein
the main unit is provided with a groove that engages with the ring-shaped member and defines its movement direction;
the locking member is provided with one part of the groove and is capable of moving relative to the main unit;
when the groove provided in the locking member and the groove provided in the main unit are in a communicating state, the ring-shaped member is capable of switching between the released state and the bound state; and
when the groove provided in the locking member and

the groove provided in the main unit are in a non-communicating state, the treatment part is held in the bound state with respect to the elongated member.

4. The surgical instrument according to claim 2 or 3, further comprising:

a treatment tool piece provided on the treatment part and is capable of operating;
a joint for operating treatment tool piece that connects the elongated member to the treatment tool piece; and
a moving member that is connected to the joint for operating treatment tool piece in order to operate the treatment tool piece, wherein
the joint for operating treatment tool piece comprises:

a first operation turning member that is connected to the moving member and turns around a predetermined center of turning;
a second operation turning member that is connected to the first operation turning member such that it turns in the opposite direction relative to the first operation turning member coaxial with the second turning axis part or around a center of turning that is nearer to the turning axis part than the second turning axis part; and
a link that converts a rotational force of the second operation turning member to an operation of the treatment tool piece;
the joint for operating treatment tool piece is detachable between the first operation turning member and the second operation turning member by being detachable from the connection part.

5. The surgical instrument according to claim 4, wherein
a pair of the treatment tool pieces, and
the operation of the treatment tool pieces is an operation of opening and closing them.

6. A medical treatment manipulator comprising:

the surgical instrument according to any one of claims 1 to 5;
a slave manipulator including at least one joint, the surgical instrument being attached to the slave manipulator; and
a master manipulator that generates operating commands for driving the joint of the slave manipulator.

FIG. 1

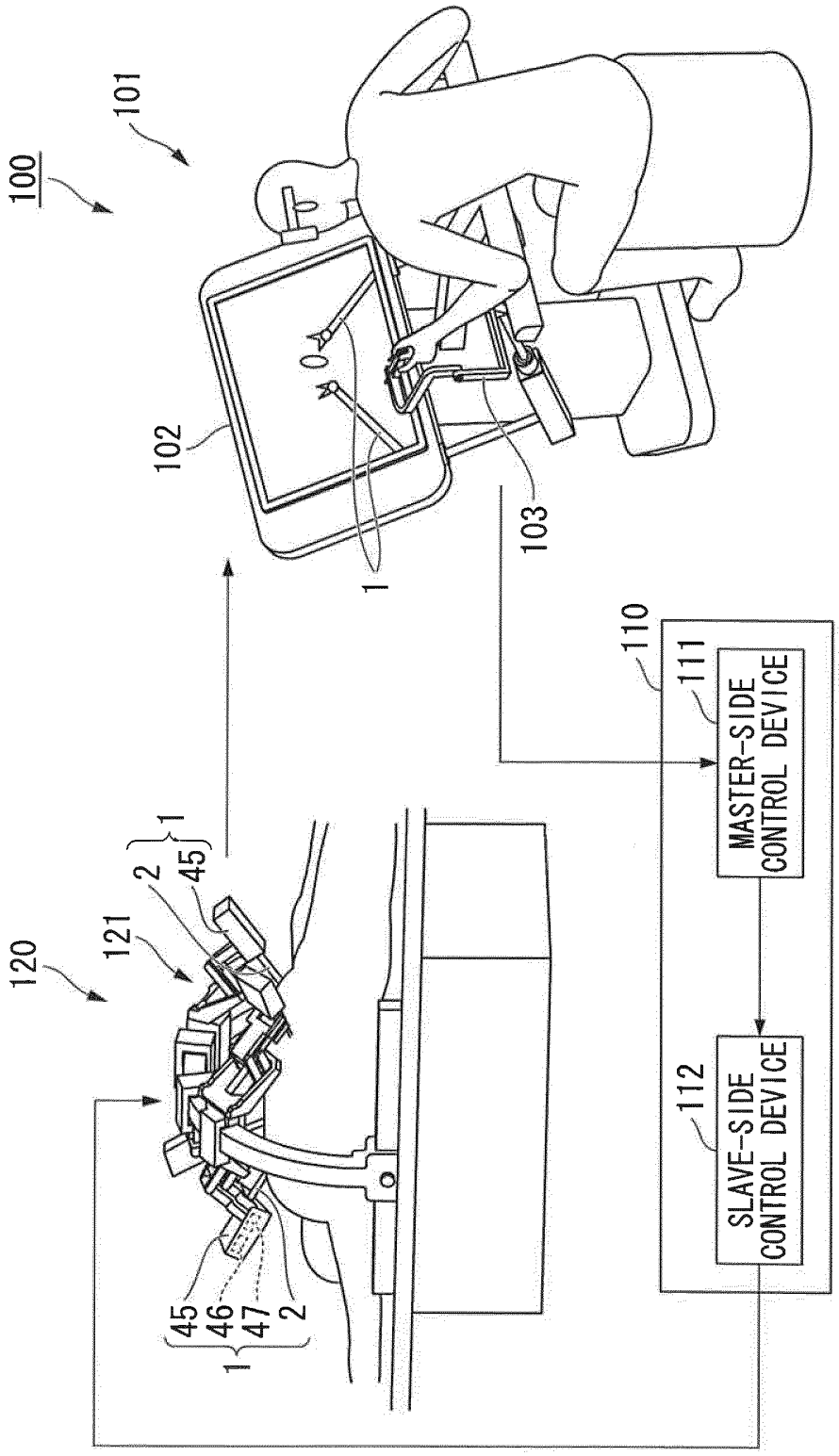

100
101
102
103
1
110
111
MASTER-SIDE CONTROL DEVICE
112
SLAVE-SIDE CONTROL DEVICE
120
121
2
45
46
47

FIG. 2

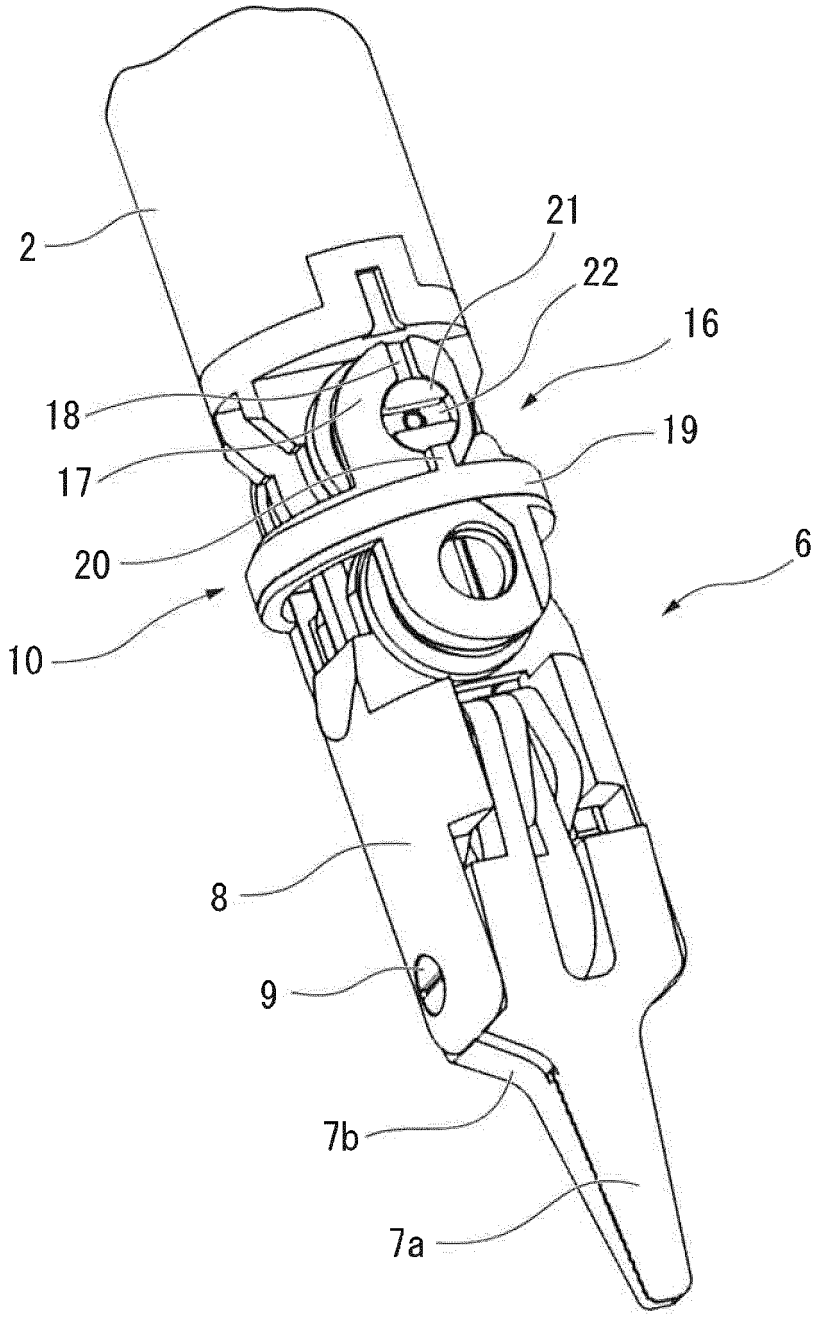


FIG. 3

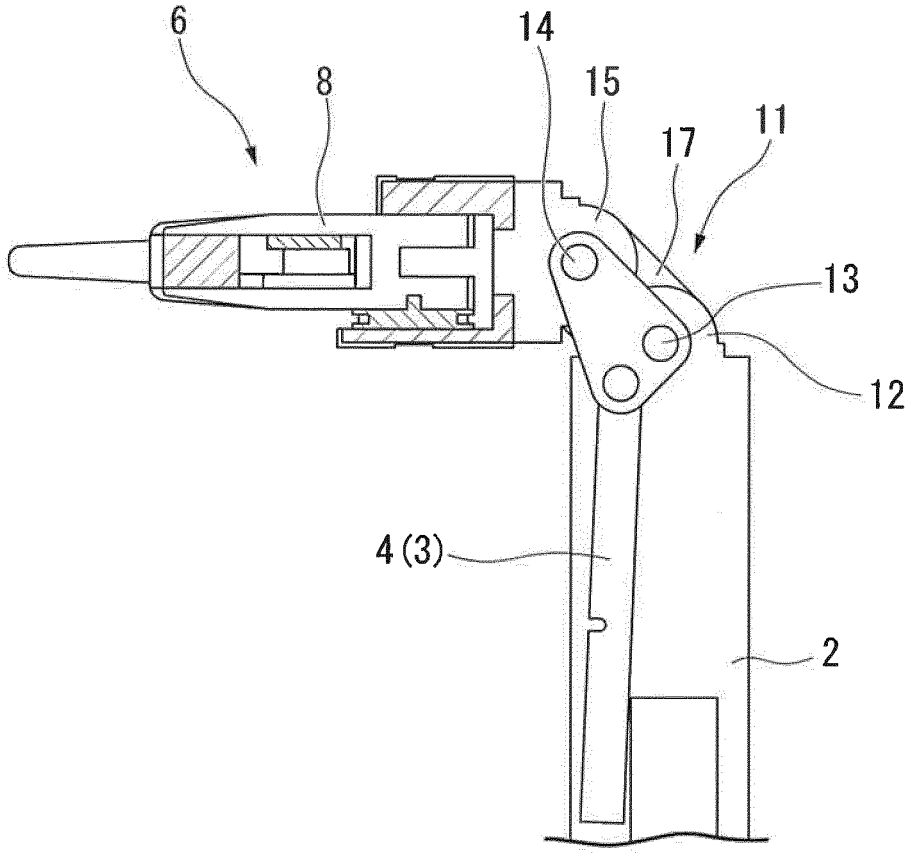


FIG. 4

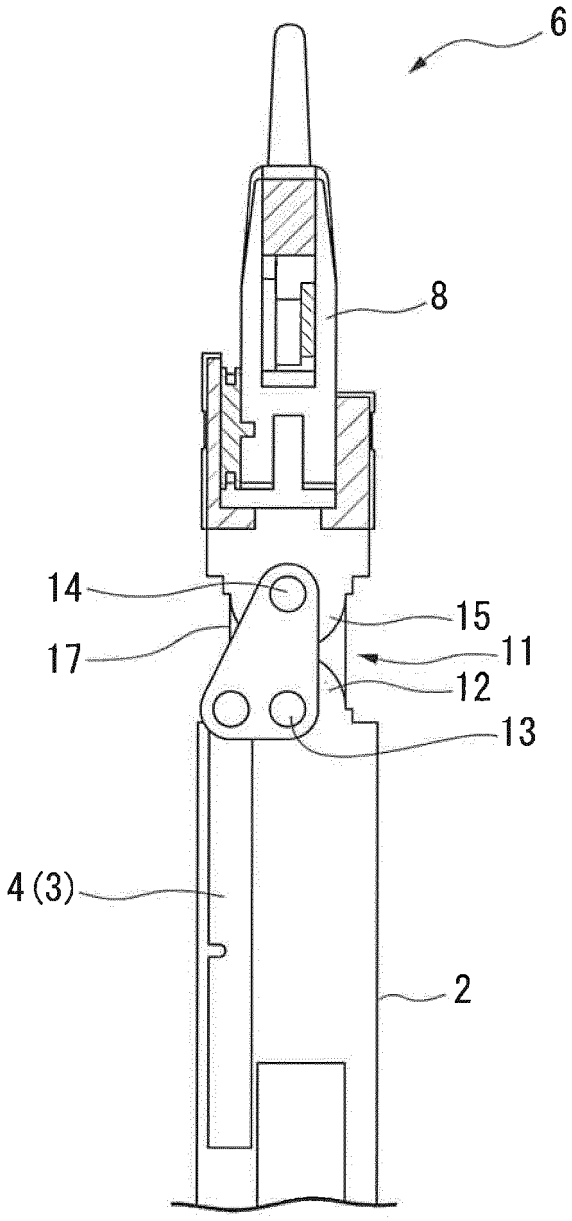


FIG. 5

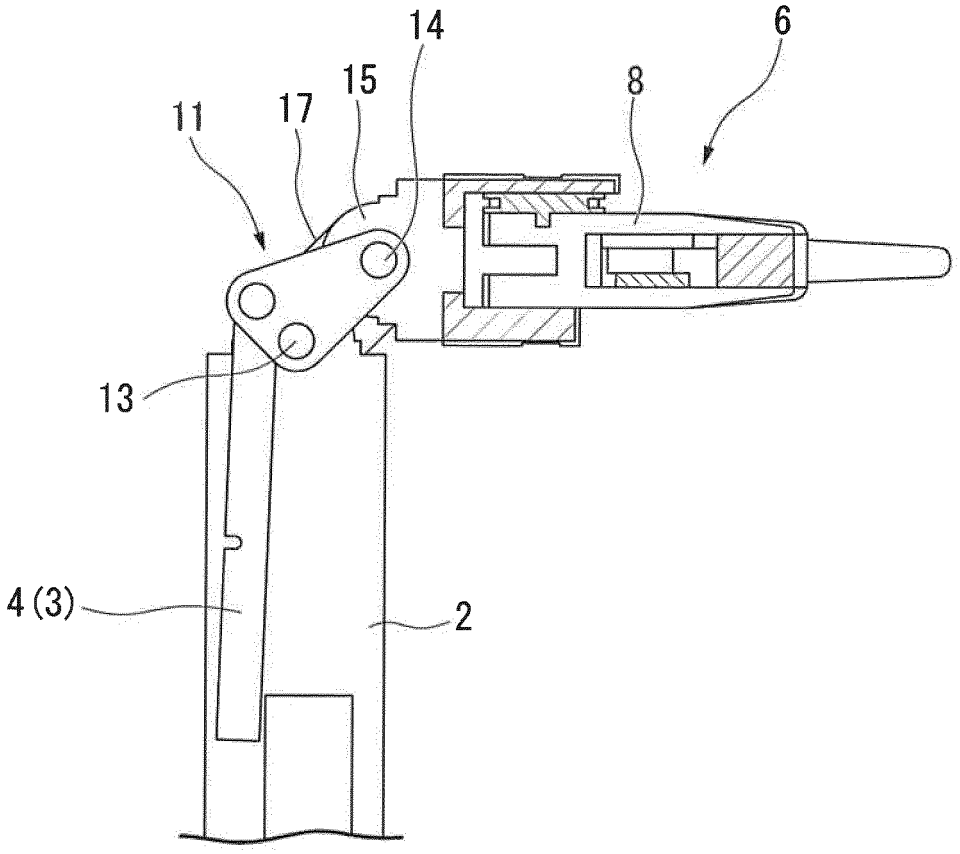


FIG. 6

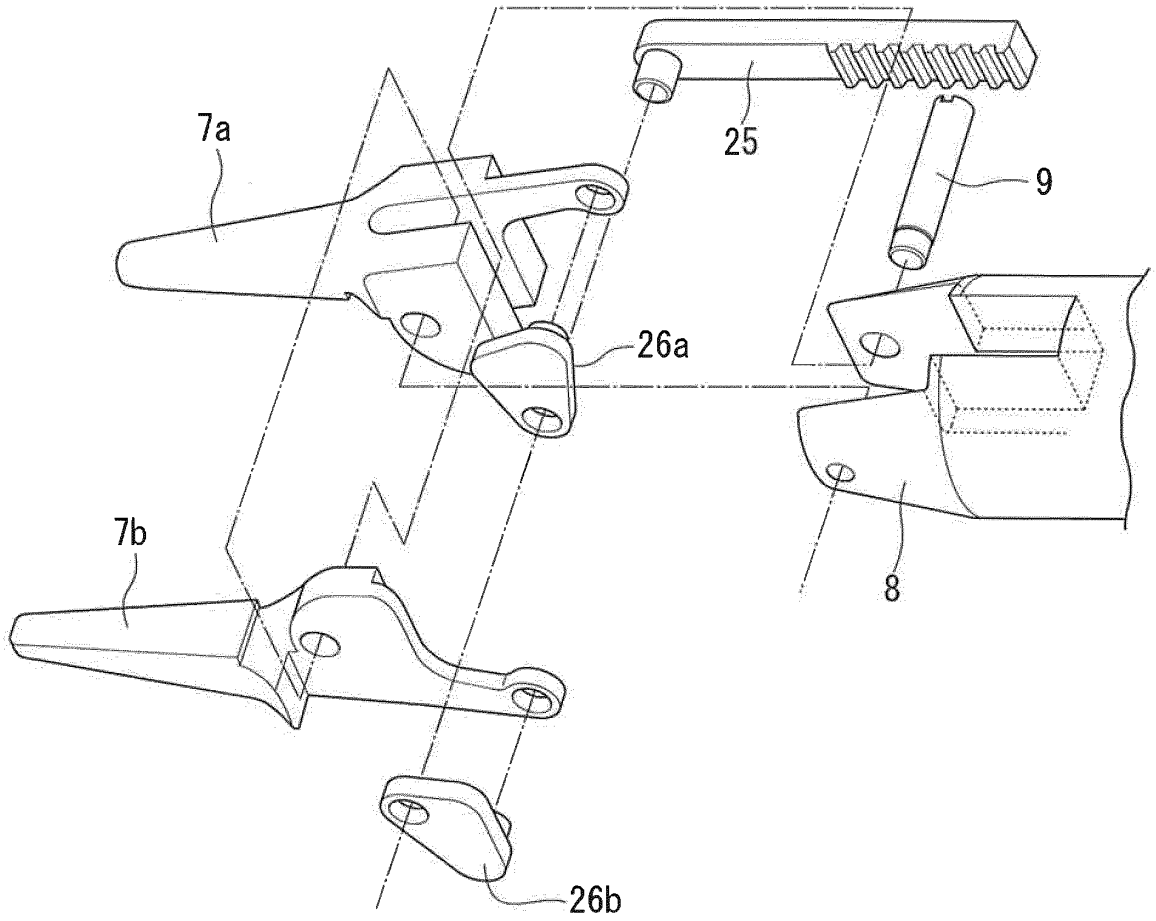


FIG. 7

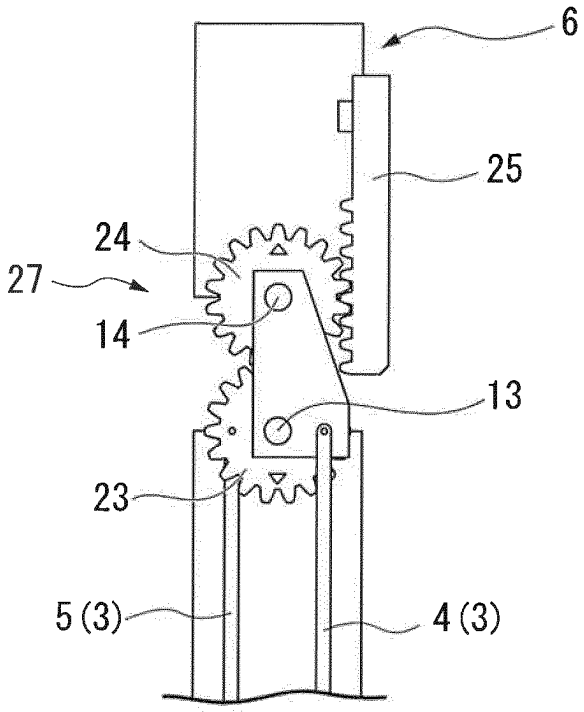


FIG. 8

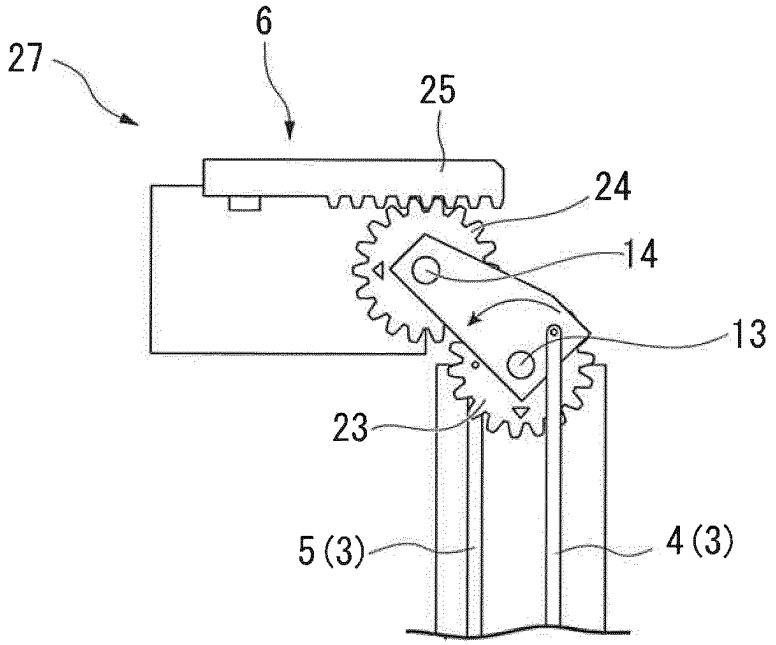


FIG. 9

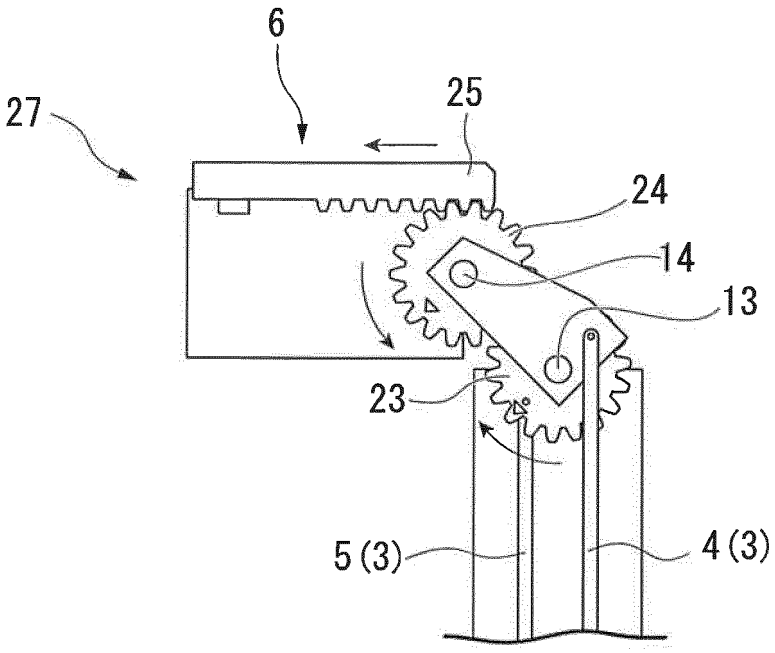


FIG. 10

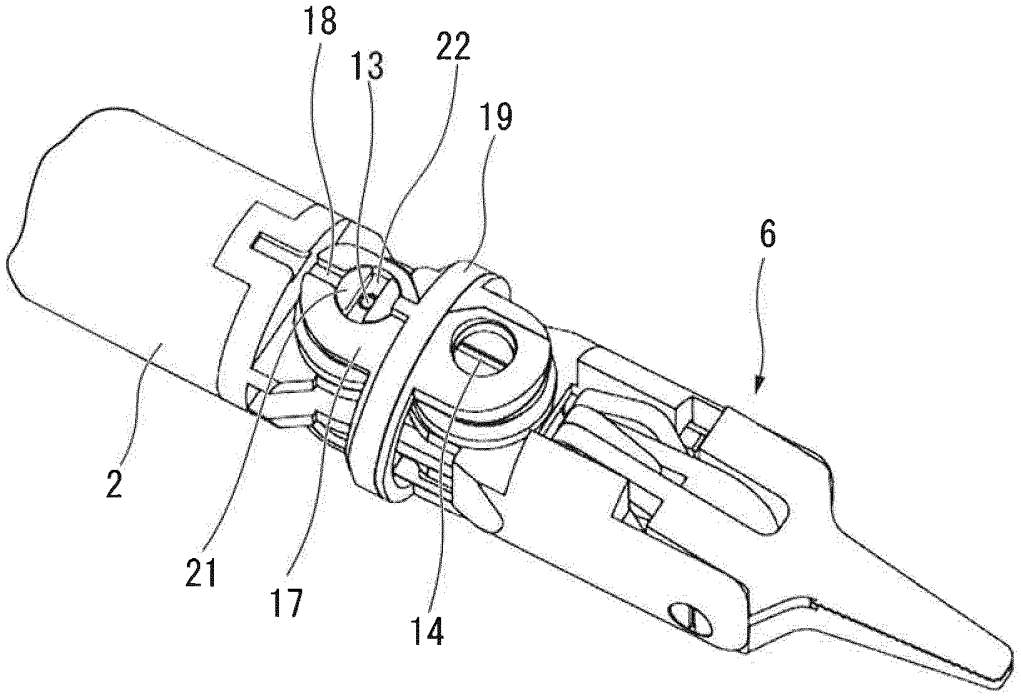


FIG. 11

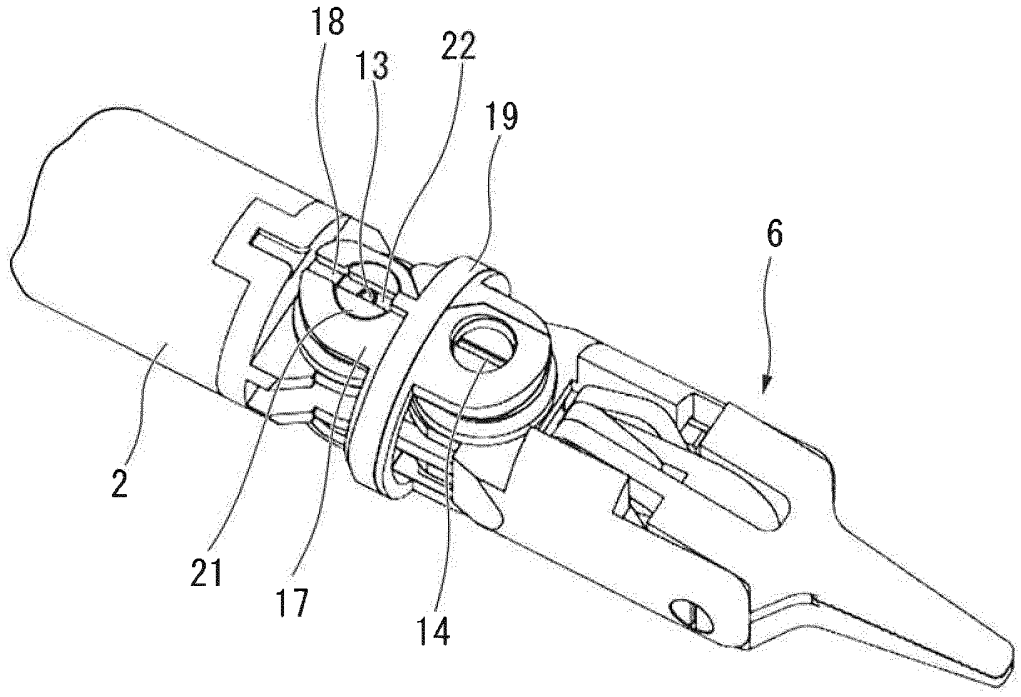


FIG. 12

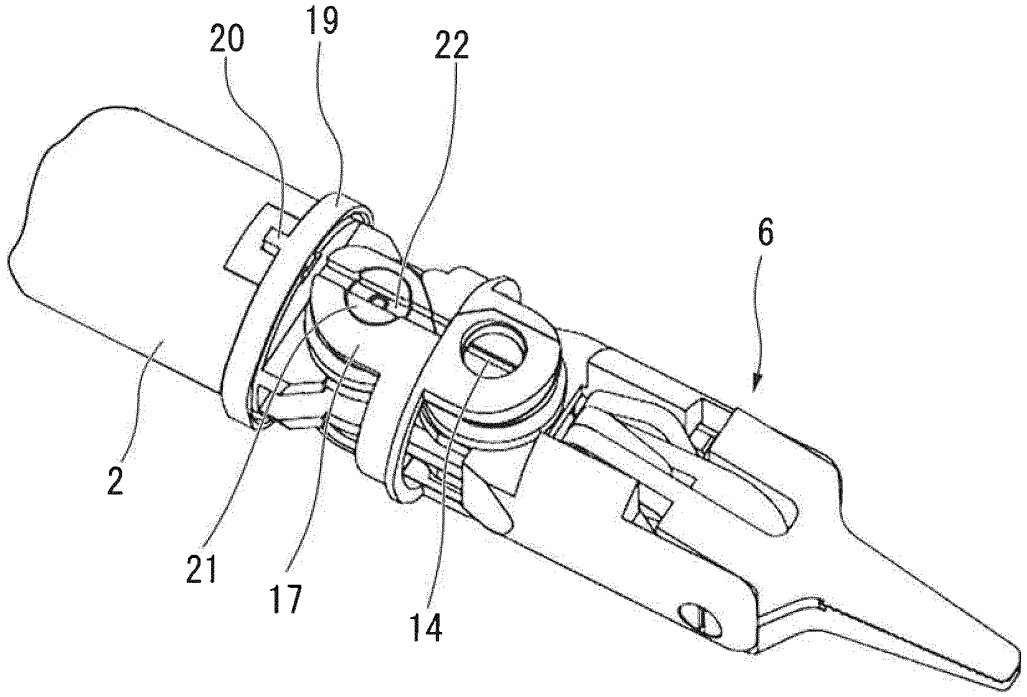


FIG. 13

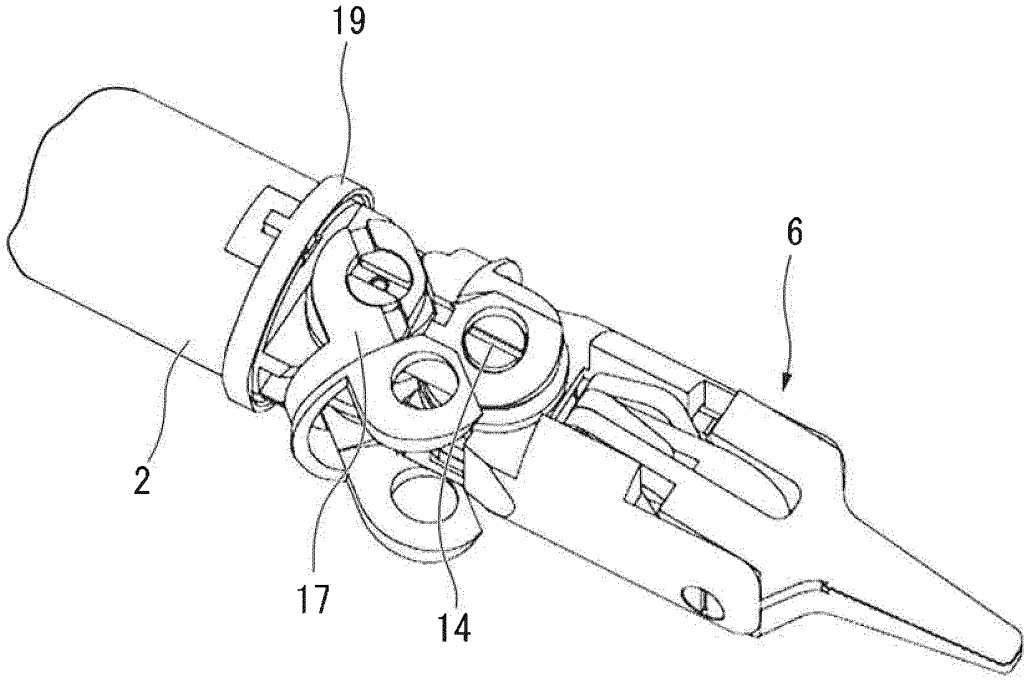


FIG. 14

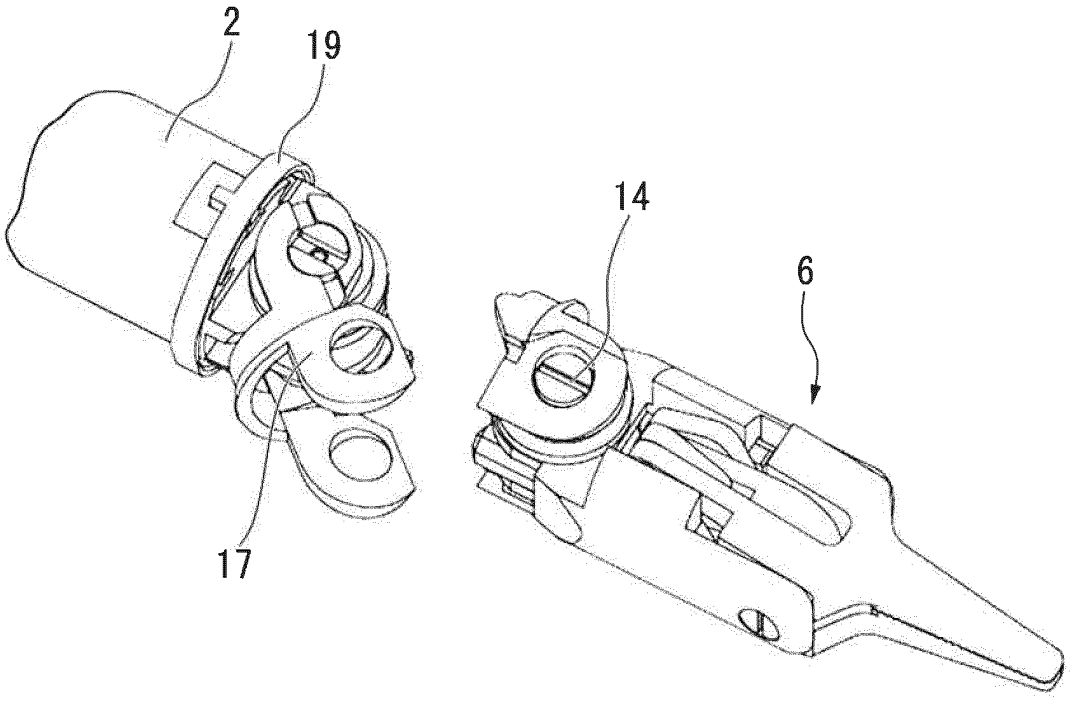


FIG. 15

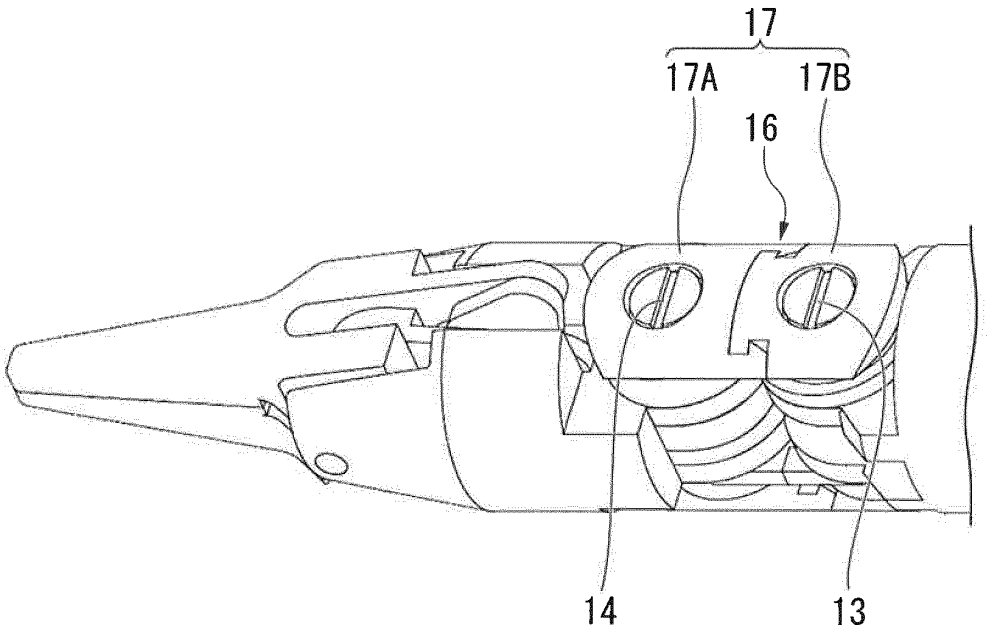


FIG. 16

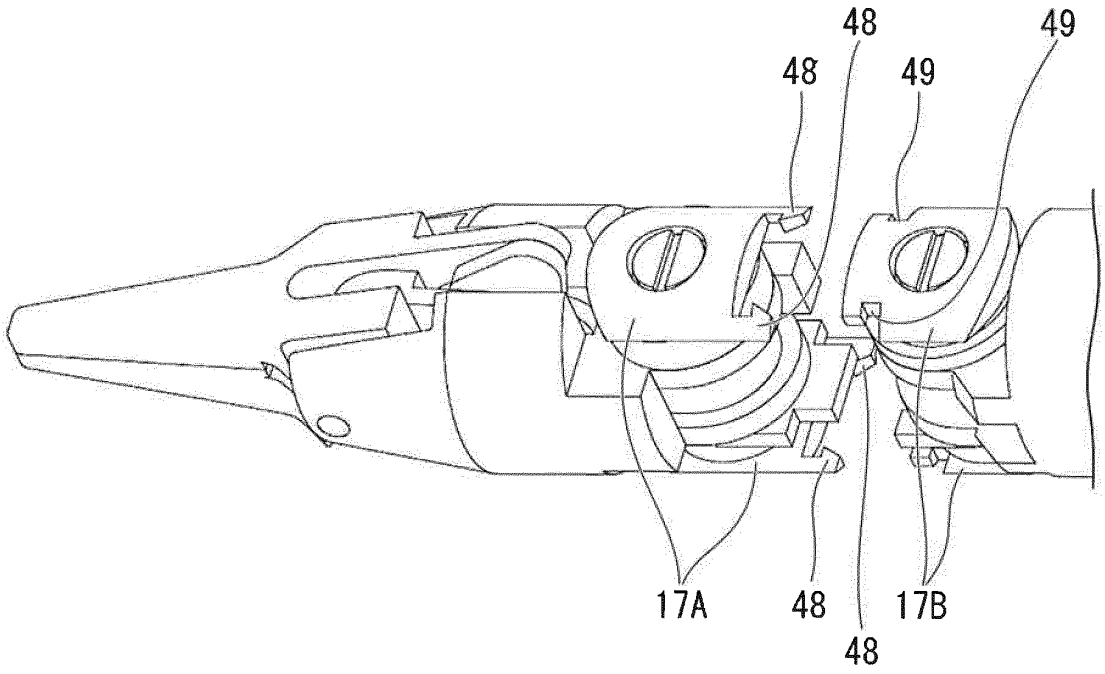


FIG. 17

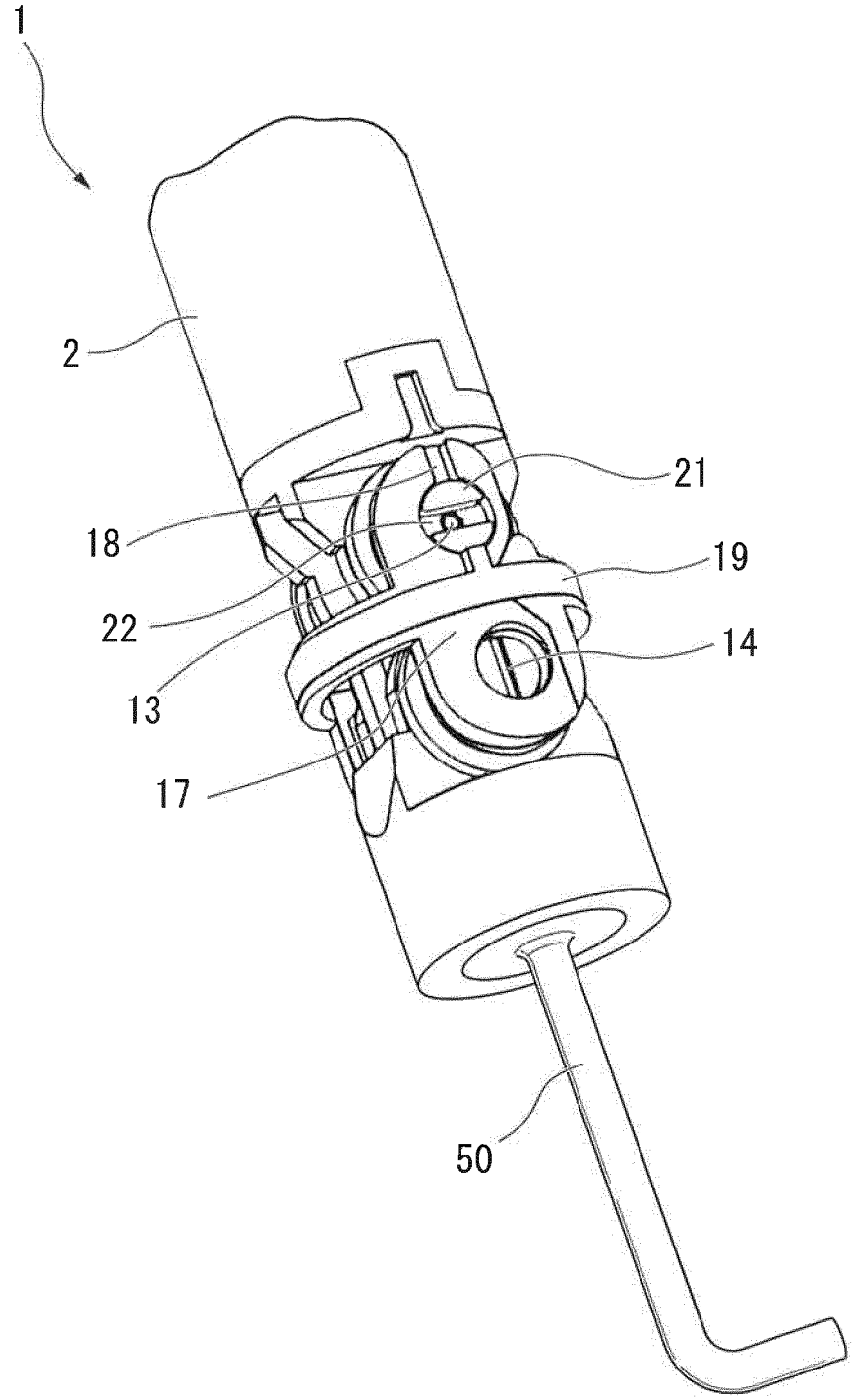
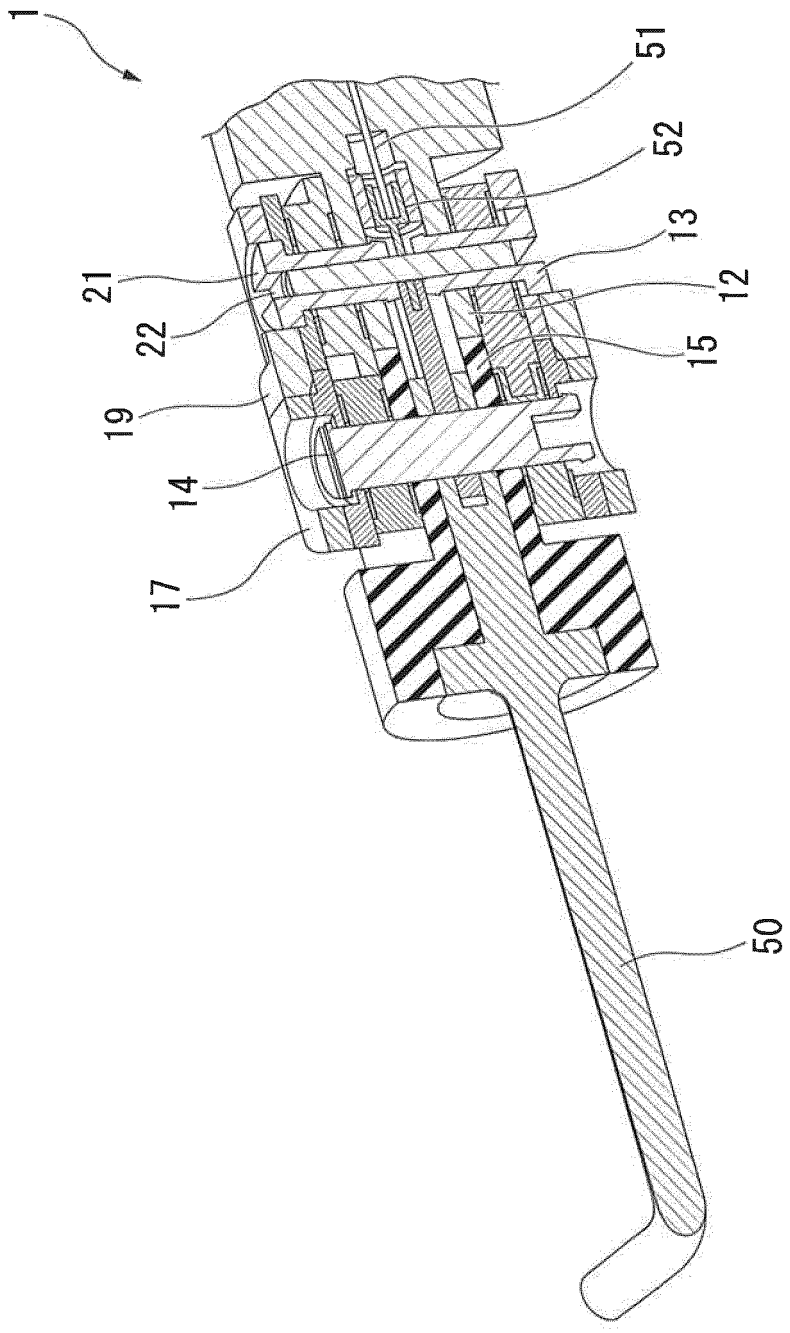


FIG. 18



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/069868

A. CLASSIFICATION OF SUBJECT MATTER
A61B19/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B19/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012
Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2008-36793 A (Terumo Corp.), 21 February 2008 (21.02.2008), paragraphs [0019] to [0020], [0028], [0042] to [0043]; fig. 8 & US 2008/0039255 A1 & EP 1886630 A2 & DE 602007007694 D & CN 101120888 A & AT 473689 T	1 6
Y	JP 7-194609 A (Olympus Optical Co., Ltd.), 01 August 1995 (01.08.1995), entire text; all drawings (Family: none)	6
Y	JP 2009-178230 A (Terumo Corp.), 13 August 2009 (13.08.2009), entire text; all drawings & US 2009/0192519 A1	6

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
06 September, 2012 (06.09.12)	18 September, 2012 (18.09.12)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/069868

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2001-277157 A (Toshiba Corp.), 09 October 2001 (09.10.2001), entire text; all drawings (Family: none)	1-6
A	JP 2007-29274 A (Hitachi, Ltd.), 08 February 2007 (08.02.2007), entire text; all drawings (Family: none)	1-6

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 61515203 B **[0002]**
- JP 2001277157 A **[0005]**